

A record of Asian agama of the genus *Calotes* Cuvier, 1817 (Squamata: Agamidae) in Kenya

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Abstract. Agamas of the genus *Calotes* Cuvier, 1817 occur in South and Southeast Asia. The garden lizard, *Calotes versicolor* (Daudin, 1802), was introduced or dragged to several places and islands in Asia, Indian Ocean and USA (Florida). The record of this species in Africa was regardless unexpected. We demonstrate the first record of *Calotes versicolor* in the African continent. Besides recognizing this species from the photograph, we were also able to identify it by using DNA sequencing.

Key words. *Calotes versicolor*, invasive species, African herpetofauna, distribution.

INTRODUCTION

Agamas of the genus *Calotes* Cuvier, 1817 occur in South and Southeast Asia (MOODY 1980, MANTHEY & SCHUSTER 1996). The garden lizard, *Calotes versicolor* (Daudin, 1802), is widespread in South and Southeast Asia. Its area of distribution extends from Southeastern Iran and Afghanistan to Nepal, India, Sri Lanka, Myanmar, Indo-China, Southern China, Malaysia and Sumatra (MANTHEY & SCHUSTER 1996, RADDER 2006). This species probably colonized Sri Lanka thanks to human settlers and became more abundant in areas with extremely disturbed vegetation (ERDELEN 1984).

There are many regions or places in Asia and in the Indian Ocean where *Calotes versicolor* has been introduced or dragged. These are e.g.: Sumatra (ROOIJ 1915), Réunion and Mauritius (VINSON & VINSON 1969), Celebes (ERDELEN 1978), the Maldives (HASEN DIDI 1993), Oman (SEUFER et al. 1999) and the Seychelles (MATYOT 2004). Finally, the garden lizard has also been introduced to Florida in the USA (ENGE & KRYSKO 2004). This species is adaptable and has a potential to be an invasive species with negative ecological impacts in the areas where it has been dragged (MATYOT 2004; RADDER 2006).

RECORD, METHODS AND RESULTS

Locality: Mombasa, railway station (GPS: S 04°03'27'' E 039°39'37'', 20 m a.s.l.).

The first find was made on March 11, 2007 about 11 p.m. The individual, a female, was sitting on a metal container approx. 80 cm above the ground. The agama was caught, photographed (Fig. 1 and 2), and a sample for a DNA analysis was taken using buccal swabs.

Another observation was done during a short excursion on March 21, 2007 (about 6 p.m.). As previously, a single individual was sitting on a heap of old metal railway ties (Fig. 3) approx. 100 m from the first finding. Theoretically, this individual might have been the same as the first one. Its capture was unsuccessful and further identification was therefore impossible. The animal hid in the heap of ties. However, it was probably a female.

The railway station in Mombasa is situated close to the centre of the city. The territory of the station is fenced and guarded. The area of the station is several hectares large and its space is fragmented by used and unused buildings, wagons, containers, railroad ties, beams, planks, etc. The railway connects the railway station in Mombasa with the industrial port (Kilindini Harbour) distant by about one kilometer. The Mombasa railway station and port serve as a transship point for container transfer.

We also observed a second agama species at the Mombasa railway station. It was a member of the *Agama lionotus* complex. According to the referred occurrence (SPAWLS et al. 2004, BÖHME et al. 2005) it could be *A. l.*



Fig. 1. *Calotes versicolor* from the Mombasa railway station. (11. III.2007; photo M. Lazurková).

lionotus. We saw males, females and offspring. We have also observed one gecko *Hemidactylus* cf. *platycephalus* and one specimen of *Hemidactylus* sp.

DNA was extracted from the buccal swab using NucleoSpin Tissue kit (Macherey-Nagel) following the manufacturer's protocol for buccal swabs. Fragments of mitochondrial cytochrome b gene and nuclear oocyte maturation factor mos (*c-mos*) gene were amplified by polymerase chain reaction using primers for cytochrome b from BURBRINK et al. (2000) and primers designed by SAINT et al. (1998) for *c-mos*. The sequencing was done with the same primers in the Abi Prism 3100 Avant Genetic Analyzer using the Abi Prism BigDye Terminator v 3.1 Ready Reaction Cycle Sequencing Kit (Applied Biosystems) in the sequencing laboratory of Charles University in Prague, Czech Republic. The obtained partial 420 bp sequence of *c-mos* gene was 99% identical with the sequence of *c-mos* gene of *Calotes versicolor* from GenBank (Acc. No. AF137525). We were unsuccessful in amplification of the whole mitochondrial gene for cytochrome b; however, two unambiguously sequenced fragments of this gene (245 bp and 364 bp) were identical with the cytochrome b sequence of *Calotes versicolor* from GenBank (Acc. No. AB183287) in 82 % and 84 %, respectively.

DISCUSSION

Based on the comparison of DNA from our sample and sequences published in GenBank, we can, with high confidence, confirm finding individuals of *Calotes versicolor* in Kenya. The lower correspondence in sequence composition in the cytochrome b gene might be explained by a faster rate of evolution of this fragment and the existence of multiple cryptic species in the *Calotes versicolor* group, as described previously by ZUG et al. (2006), who however used another fragment of mitochondrial DNA.

The finding of one or two individuals of *Calotes versicolor*, although within a short time period, suggests a recent introduction. With regard to the proximity of the Kilindini Harbour the introduction was probably accomplished through shipping. The question is from which country the animals originate. Thanks to the lower correspondence in sequence composition in the cytochrome b gene mentioned above we can exclude Myanmar. The specimens from Mombasa presumably look like the specimens from islands Réunion and Mauritius (W. DENZER, Oxford, pers. comm. 2008).

Further faunistic research in Mombasa, namely at the railway station and the port, would be useful for a surveil-



Fig. 2. *Calotes versicolor* from the Mombasa railway station. (11. III.2007; photo H. Šanderová).



Fig. 3. *Calotes versicolor* from the Mombasa railway station. (21. III.2007; photo M. Šandera).

lance of the potential population of the *Calotes* agamas in Kenya. Their impact on the local herpetofauna (namely on other lizards) and on invertebrate fauna should also be investigated. The garden lizard could represent an invasive species in Kenya with negative ecological impacts. DIONG et al. (1994) have pointed out to the fact that in Singapore it has somewhere displaced the native *Bronchocela cristatella*. MAUREMOOTO et al. (2003) include

C. versicolor in the list of introduced vertebrates with a significant impact on native biodiversity in Mauritius, namely geckos, and consumes native invertebrates. VINSON (1968) assumed that *C. versicolor* may have been responsible for the disappearance or decrease of phasmids in Réunion and Mauritius.

Similar findings of introduced or dragged *Calotes versicolor* from other countries can also be expected in other places beside Africa.

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REFERENCES

- BÖHME, W., WAGNER, P., MALONZA, P., LÖTTERS, S. & J. KÖHLER (2005): A New Species of the *Agama agama* Group (Squamata: Agamidae) from Western Kenya. *Russian Journal of Herpetology* **12** (2): 142–150.
- BURBRINK, F. T., LAWSON, R. & J. B. SLOWINSKI (2000): Mitochondrial DNA phylogeography of the polytypic North American rat snake (*Elaphe obsoleta*): A critique of subspecies concept. *Evolution* **54**: 2107–2118.
- DIONG, C. H., CHOU, L. M. & K. K. P. LIM (1994): *Calotes versicolor*, the changeable lizard. *Nature Malaysiana* **19**: 46–54.
- ENGE, K. M. & K. L. KRYSKO (2004): A new exotic species in Florida, the bloodsucker lizard, *Calotes versicolor* (Daudin, 1802) (Sauria: Agamidae). *Biological Science* **67** (3): 226–230.

- ERDELEN, W. (1978): Distributional patterns of the genus *Calotes* (Sauria, Agamidae) in Sri Lanka. *Loris* **14** (6): 350–356.
- ERDELEN, W. (1984): The genus *Calotes* (Sauria, Agamidae) in Sri Lanka: distribution patterns. *Journal of Biogeography* **11**: 515–525.
- HASEN DIDI, N. T. (1993): Observation on the nesting of a garden lizard (*Calotes versicolor*) in the Maldives. *Hamadryad* **18**: 42.
- MANTHEY, U. & N. SCHUSTER (1996): *Agamid Lizards* (Engl. ed.). T.F.H., Neptune City, 189 pp.
- MATYOT, P. (2004): The establishment of the crested tree lizard, *Calotes versicolor* (Daudin, 1802) (Squamata: Agamidae), in Seychelles. *Phelsuma* **12**: 35–47.
- MAUREMOOTOO, J. R., LECKRAZ, N. R., PUTTOO, M., BELLOUARD, E., GANESHAN, S. & S. P. BENI MADHU (2003): Invasive alien species of Mauritius. Pp. 12–37 in: MACDONALD, I. A.W., REASER, J. K., BRIGHT, C., NEVILLE, L. E., HOWARD, G. W., MURPHY, S. J. & G. PRESTON (eds.): *Invasive alien species in southern Africa: national reports & directory of resources*. Global Invasive Species Programme (GISP), Cape Town, South Africa.
- MOODY, S. M. (1980): Phylogenetic relationships and historical biogeographical relationships of the genera in the family Agamidae (Reptilia: Lacertilia). PhD dissertation. University of Michigan. 373 pp.
- RADDER, R. S. (2006): An overview of geographic variation in the life history traits of the tropical agamid lizard, *Calotes versicolor*. *Current Science* **91** (10): 1354–1363.
- ROOIJ, N. de (1915): *The reptiles of the Indo-Australian Archipelago*. E. J. Brill, Leiden. 384 pp.
- SAINT, K.M., AUSTIN, C.C., DONNELLAN, S.C. & M. N. HUTCHINSON (1998): C-mos, a nuclear marker useful for squamate phylogenetic analysis. *Molecular Phylogenetics and Evolution* **10**: 259–263.
- SEUFER, H., KOWALSKI, T. & H. J. ZILGER (1999): Herpetologische Impressionen einer Reise in den Oman. *Herpetofauna Weinstadt* **21**: 24–34.
- SPAWLS, S., HOWELL, K., DREWES, R. C. & J. ASHE (2004): *Field Guide to Reptiles of East Africa* (reprint). A & C Black, London. 543 pp.
- VINSON, J. (1968): Les Blattoptéroïdes, Orthoptéroïdes et Dermatoptéroïdes des Mascareignes. *The Mauritius Institution Bulletin* **6** (3): 103–118.
- VINSON, J. & J. M. VINSON (1969): Saurian Fauna of Mascarene Islands. *The Mauritius Institution Bulletin* **6**: 203–320.
- ZUG, G. R., BROWN, H. H. K., SCHULTE, J. A. & J. V. VINDUM (2006): Systematics of the Garden Lizards, *Calotes versicolor* Group (Reptilia, Squamata, Agamidae), in Myanmar: Central Dry Zone Populations. *Proceedings of the California Academy of Sciences ser. 4*, **57** (2): 35–68.